
Space Weather Technical Forecast

Issued on Saturday, 16 March 2024 at 01:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Slight chance of M-flares (R1/R2 Radio Blackouts). Ongoing S1/Minor Radiation Storm easing, falling below thresholds later day 1 (16 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with a long period C5.9 flare peaking at 15/0610 UTC from ex-3599 over the west limb. There are currently four numbered sunspot regions on the visible disc, and one new unnumbered spot in south-centre disk. All regions are small and simple at present, with very little recent change to any of the numbered spots.

The long period C5.9 flare produced a CME directed towards the southwest. Given the location any interaction at Earth is likely to be mostly shock.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by DSCOVR and ACE were slow-ambient to slightly elevated, varying between 360-450 km/s. Density was below average. The Interplanetary Magnetic Field, Bt, was weak, gradually falling from 7nT to 4nT. The north-south component, Bz, was mostly positive, but varied between +5/-5nT. The phi angle was positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was initially at background levels, but rose after the C5.9 flare, rising above the S1 Radiation Storm level from 15/2050 UTC and reaching a maximum of 10.6 pfu at 15/2215 UTC.

High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The observed 24-hour fluence was steady below the Active threshold, with the value at 16/0000 UTC being 4.7e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a slight chance of M-class flares throughout, initially from an off-going active region and later from a returning active region.

Solar Wind / Geomagnetic Activity: None of the CMEs seen in coronagraph imagery have been deemed Earth-directed. However, there are two CMEs which may give minor glancing impacts, and the CME associated with the long period C5.9 flare early on 15 Mar may give shock effects at Earth in the period. Any of the glancing or shock effects are most probable on days 2 and 3 (17 or 18 Mar). Otherwise solar winds are expected to remain at Slightly Elevated to Slow-Ambient levels, perhaps with a minor enhancement from coronal hole 10.

Mostly Quiet or Unsettled (Kp 0-3) conditions are expected over the period, with a chance of an Active (Kp 4) and a Slight Chance of G1/Minor Storm (Kp 5) intervals on days 2 and 3 (17 & 18 Mar) should any of the 2 glancing CMEs/the CME shock or a stronger connection to the CH10/-HSS occur.

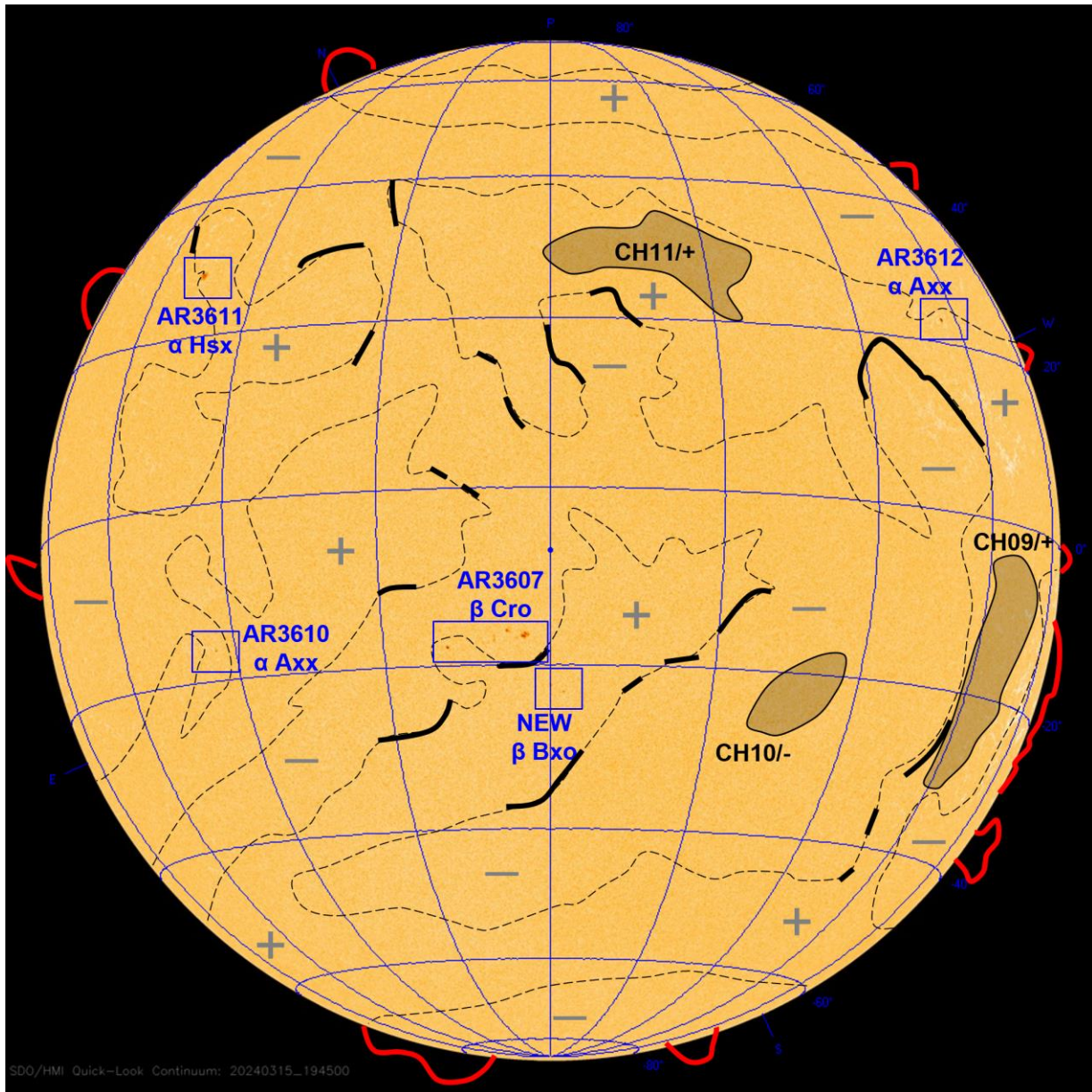
Energetic Particles / Solar Radiation: Proton flux at GOES18 rose above the S1/Minor Radiation storm threshold from 15/2050 UTC. The risk of further proton events remains until later on 16 Mar, with a decline in probability thereafter. The current elevated proton count is

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expected to gradually decline through day 1, likely falling below the S1/Minor Radiation storm threshold by day 2 (17 Mar).

High energy electron flux (greater than 2MeV) is currently at background levels and expected to stay that way. 24-hr integrated fluence is likely to remain below the Active threshold throughout.

Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

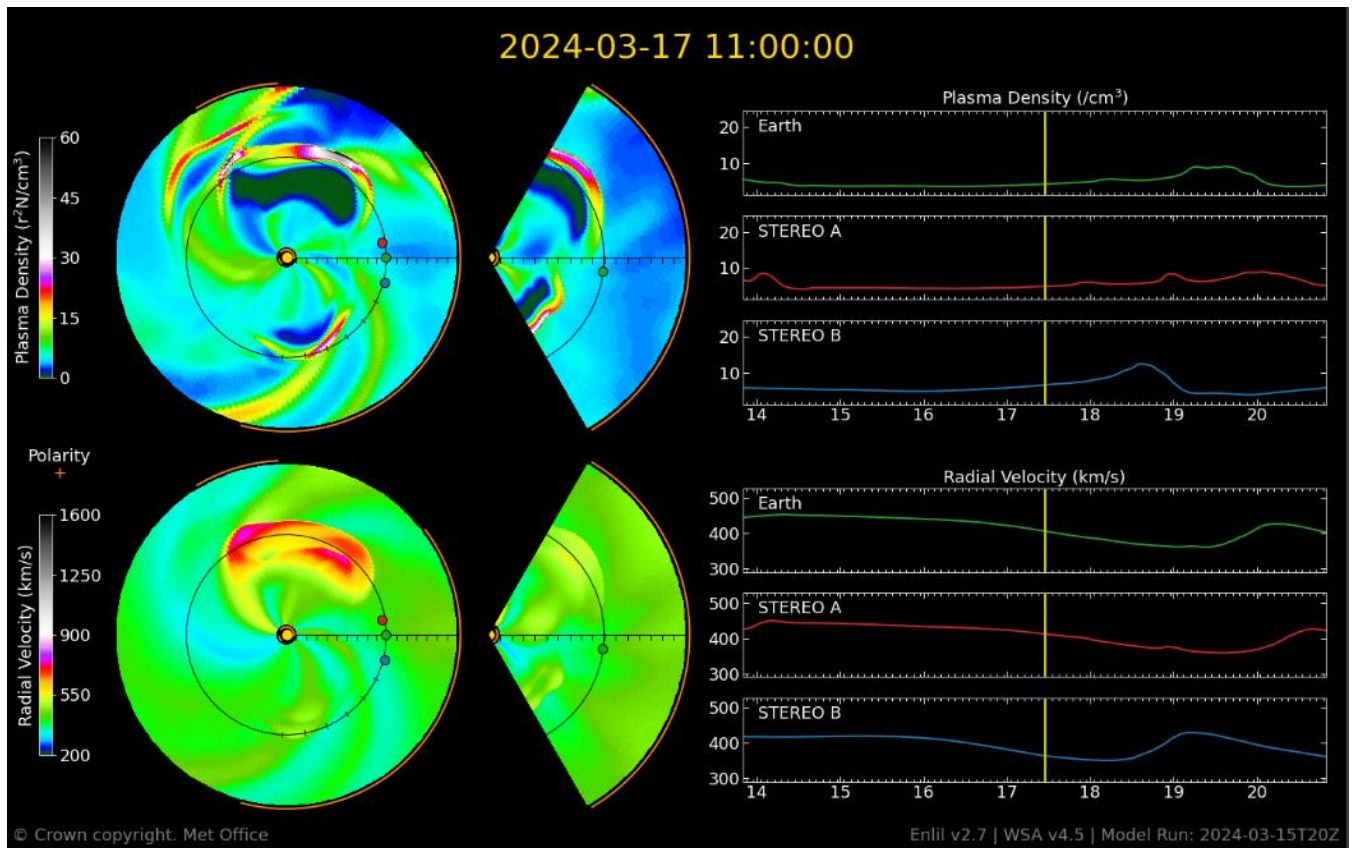
The CME associated with the long period C5.9 flare this morning from ex-3599 over the west limb is expected to miss, though may give a shock interaction at Earth, potentially on days 2-3 (17-18 Mar). A filament eruption from north centre disk on 14 March is expected to miss above Earth on day 2 or 3 (17 or 18 Mar), but also may give a slight glance. A CME from 15 March with an unknown source is expected to miss below Earth on days 2 or 3 (17 or 18 Mar), but may also may give a slight glancing influence.

The slightly elevated winds currently observed are thought to emanate from a weak, but waning, connection to a high speed stream from CH09/+. The small negative polarity coronal hole, CH10/- will rotate into a more geoeffective position later day 1 (16 Mar) or more likely day 2 (17 Mar), however it is such a small feature that any HSS from this is unlikely to give significant impacts at Earth. We also have CH11/+ in the northern hemisphere, which was present on the previous rotation, but gave little impact at Earth and similar is expected this time around.

Mostly Quiet or Unsettled (Kp 0-3) conditions are expected over the period, with a chance of an Active (Kp 4) and a Slight Chance of G1/Minor Storm (Kp 5) intervals on days 2 and 3 (17 & 18 Mar) should any of the 2 glancing CMEs/the CME shock or a stronger connection to the CH10/- HSS occur.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	20	20	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MSWOC ENLIL showing missing CME's.



Radio Blackouts - X-Ray Flares:

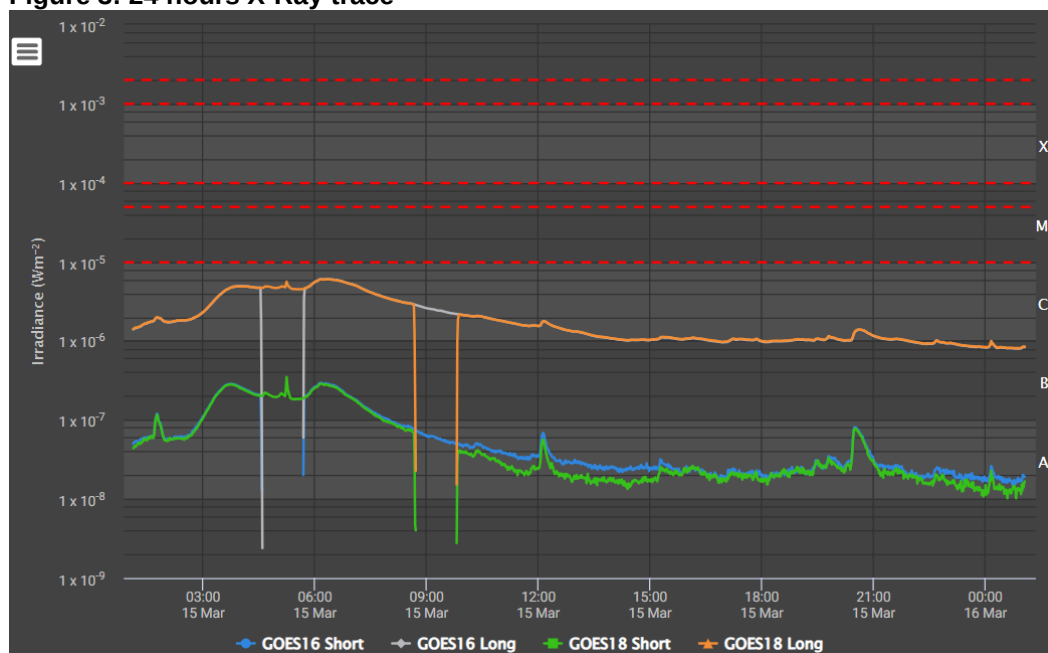
Solar activity has been Low, with a long period C5.9 flare peaking at 15/0610 UTC from ex-3599 over the west limb. There are currently four numbered sunspot regions on the visible disc, and one new unnumbered spot in south-centre disk. All regions are small and simple at present, with very little recent change to any of the numbered spots.

Ex-3599 continues to contribute a declining amount to the X-ray flare forecast through Day 1 (15 Mar) before it rotates sufficiently beyond the western limb to lose influence. Helioseismology suggests that a larger region is projected to rotate onto the disc probably later on day 1 or into day 2 (16-17 Mar); this may be ex-3590, which was the source of several Strong flares on the previous rotation. The return of this region is reflected by the slight increase in flare probabilities from 17 Mar, however confidence in this is low until the region rotates onto the disc and can be assessed.

Activity is expected to remain Low with a slight chance of becoming Moderate, should any isolated M-class flares occur, most likely from ex-3599 at first, then from the potential ex-3590 later in the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	20	20	20
Very Active	R3 to R5 X Class	No	1	5	5	5

Figure 3: 24 hours X-Ray trace



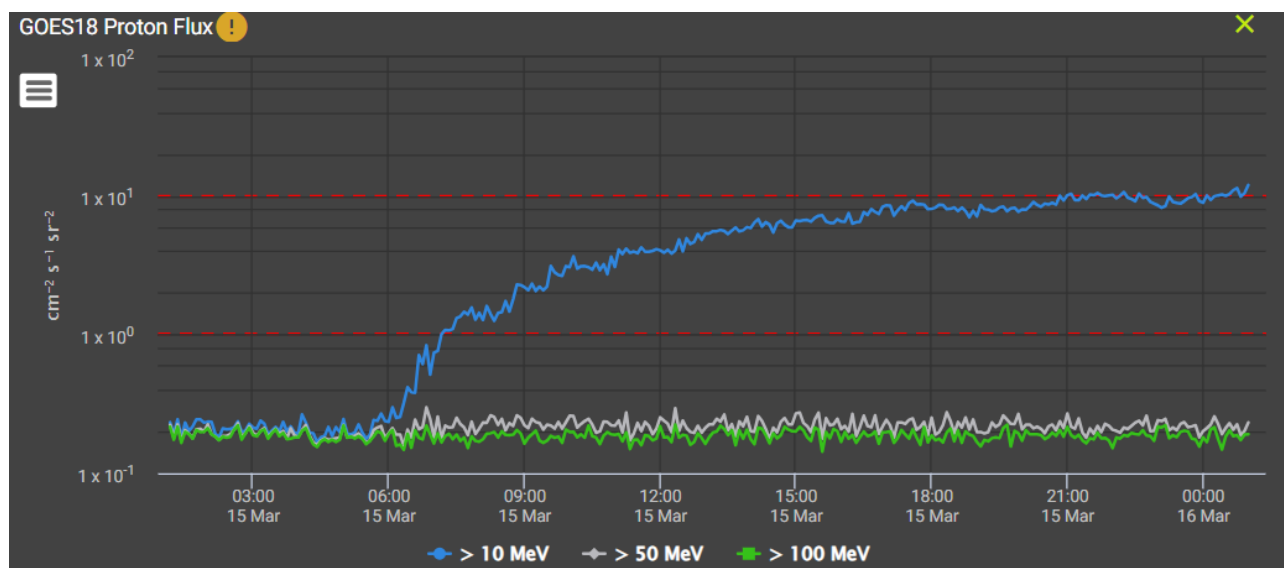
Solar Radiation Storms - (High Energy Protons):

Proton flux at GOES18 has increased somewhat in response to the long period C5.9 flare early on 15 Mar from ex-3599 over the west limb. Flux continued to build, rising above the S1/Minor Radiation storm threshold from 15/2050 UTC. The risk of further proton events from this region remains until it reaches around W120-130 later on 16 Mar, with a decline in probability thereafter. The current elevated proton count is expected to gradually decline through day 1, likely falling below the S1/Minor Radiation storm threshold.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	90	20	5	1
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

Figure 4: 24 hour Proton trace.



High Energy Electrons Event ($\geq 2\text{MeV}$):

Over recent days the high energy electron flux (greater than 2MeV) has shown a decreasing trend and is now near background levels. Given the absence of any significant enhancement in the forecast, this is expected to continue.

The associated 24-hr integrated fluence is expected to remain well below the Active threshold throughout, which is supported by MOSWOC REFM.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM fluence forecast/observations/recurrence

